

## AS Unit 1: Basic Biochemistry and Cell Organisation

Name:	Date:
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### Topic 1.2 Cell Structure and Organisation – Page 2

#### I. Tissues

##### i.) Under the light microscope

		Completed
1.	Read about the structure of plant and animal cells as seen under the light microscope <b>W/S 1.2c Under the light Microscope</b> Underline any words you are not confident about. Highlight the names of all the organelles that you come across.	
2.	Make a table of similarities and differences between a plant cell e.g. a leaf palisade cell and an animal cell e.g. a liver cell as seen under the light microscope.	

##### ii.) Aggregation of cells

		Completed
3.	Look at the PowerPoint ' <b>Levels of Organisation</b> '.	
4.	Read about how cells become specialized and work together for form tissues. <b>W/S 1.2d Aggregation of cells.</b> a. What do we mean by an aggregation? b. What is meant by the term 'division of labour'?	
5.	<b>W/S 1.2d Aggregation of Cells</b> Complete the tasks i, ii and iii on page 6	
6.	An <b>organ</b> is an aggregation of several tissues. Choose an organ and make an A4 poster. Your poster needs to have the following: A brief description of the organ's functions. An outline of the different tissues found in the organ and where they are located. A description of how those tissues help the organ to carry out its role effectively.	

## W/S 1.2c under the light microscope

### The cell as a basic unit

Cells carry out all the essential processes that make an organism a living entity. There is really no such thing as a typical cell but, as we shall see, cells share certain structural and functional features and they are of almost universal occurrence in living organisms.

The cell is the basic structural and functional unit of an organism, and so it is not surprising that biologists have devoted a great deal of attention to its structure and the processes which go on inside. The study of cells continues to be an exciting area of research as more sophisticated techniques become available to study them.

### Cells as revealed by the light microscope

#### An animal cell as seen with a light microscope

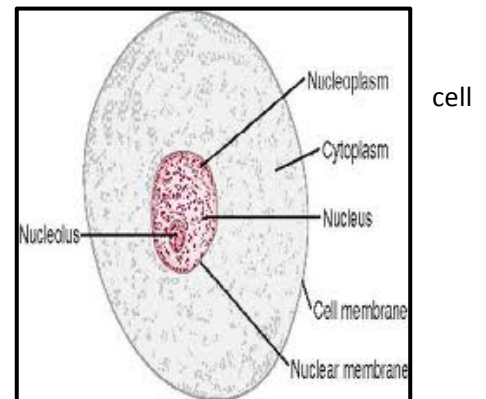
The structure of a typical animal cell as seen with a light microscope is illustrated below. The whole cell has a diameter of about one fiftieth of a millimetre (20µm). It is bound by a thin plasma membrane (also called a surface membrane). This encloses the cytoplasm that surrounds the nucleus.

On first examination the cytoplasm appears to be a uniformly homogenous substance, but closer inspection of the cells stained with special dyes shows that it contains numerous granules and inclusions. Food materials, for example glycogen (a polysaccharide), are stored in the cytoplasm and it is here that complex chemical reactions take place, building up materials and supplying energy for the cell's activities.

The nucleus is bound by a nuclear envelope and contains a dense body called the nucleolus together with a material called chromatin that condenses into distinct bodies called chromosomes when the cell undergoes division. The chromosomes carry hereditary material in the form of DNA, which determines the organism's characteristics and transmits these to subsequent generations.

The nucleus has been shown to be vital for the continued life of the cell. Certain cells are large enough to be easily enucleated; these cells after this process eventually die. However, if the nucleus is replaced sufficiently soon after it has been removed the cell can revive and continue to live.

The centriole found just outside the nuclear envelope, plays an important role in the formation of cilia and flagella, slender 'motile' hairs that project from the surface of some cells.



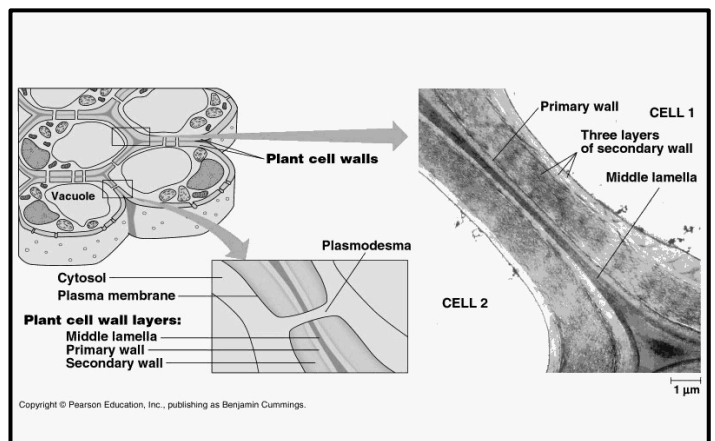
#### A plant cell as seen with a light microscope

Most of the structures found in an animal cell are found in a plant cells. A typical plant cell, however, has certain additional features. The centre of the cell is taken up by a large vacuole filled with a solution containing sugars and salts, the cell sap. The cell is bounded by a plasma membrane beyond which is a comparatively thick cell wall made of the polysaccharide cellulose. The vacuole and the cell wall play a major part in maintaining the shape and form of the cell.

The central position of the vacuole means that the cytoplasm is concentrated at the sides of the cell. In most plant cells the nucleus is usually located in this peripheral cytoplasm.

The cell wall is laid down during the development of the cell, and starts as a thin layer of pectin beneath which cellulose, secreted by the outer part of the cytoplasm, is laid down. This constitutes the primary cell wall. Further layers of cellulose constitute the secondary cell wall. The point of demarcation between one cell and the next is known as the middle lamella.

Plant cells are not isolated from their neighbours. Narrow pores carrying fine strands of cytoplasm interrupt the cellulose cell wall. These pores are called plasmodesmata and they facilitate the movement of materials between cells. Granules and inclusions found in the cytoplasm include spherical bodies called plastids. There are two types

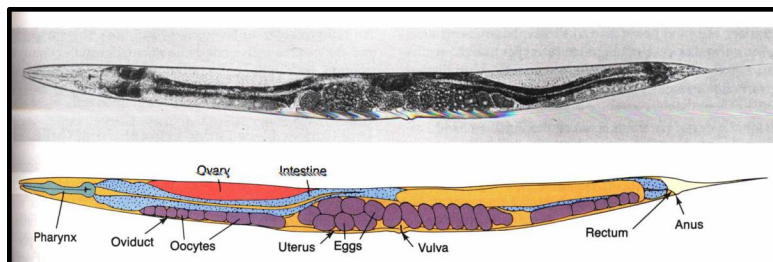


leucoplasts, which are colourless and contain starch. The other main type of plastid, chloroplasts contain the green pigment chlorophyll and they play a crucial role in photosynthesis.

## W/S 1.2d Aggregation of Cells page 1

### Multicellular Organisms

Multicellular organisms consist of a single mass of cells fused together. Humans are multicellular organisms with around ten million, million cells in an adult. One of the most studied multicellular organisms is a small worm, *Caenorhabditis elegans*. This worm measures 1mm long as an adult and consists of exactly 959 cells. It has a mouth, pharynx, intestine and anus. It has both male and female reproductive organs, and almost one third of its cells are neurons or nerve cells. Most of these are located at the front end of the worm in a structure that can be regarded as the animal's brain.

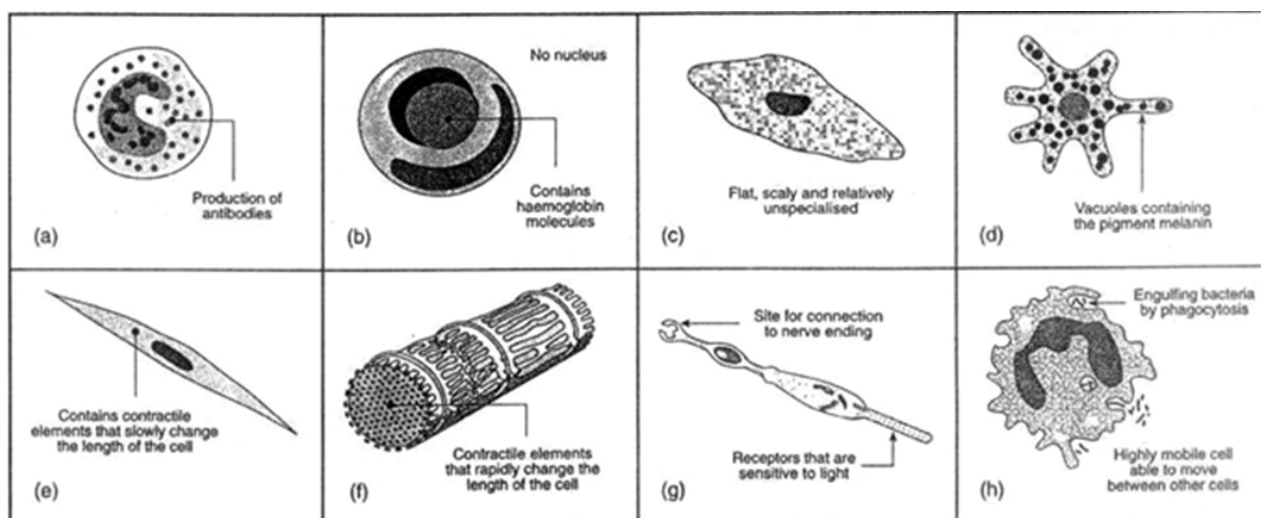


### Cell differentiation leads to specialised tissues

Multicellular organisms consist of many groups of specialised cells, making up their tissues and organs. The process by which a cell becomes much specialised to carry out a particular function is known as **differentiation**.

Below are some examples of human cells that have become specialised to carry out particular functions:

Select three cells that you can identify. For each of the cells you have chosen describe their specialized features:



Cell name			
Specialisation			

When cells differentiate and become specialized they become much more efficient at carrying out a particular function. Differentiation involves changes in both the shape and physiology of the cell. Every cell in the human body (exception gametes) contains the same genetic information. Differentiation occurs because different genes are 'switched on' and 'switched off' in different cells depending on their destined role.

For example in nerve cells genes will be switched on to allow the cell to form long extensions, structures and chemicals that will allow it to transmit nerve impulses. Genes that would give the cell undesirable features will be switched off.

In multicellular organisms, each type of cell specialises in performing a particular function. Thus, the functions of a multicellular organism as a whole are divided amongst its different specialised cells, each of which performs a particular function efficiently. This dividing up of the functions is known as **division of labour**. Division of labour allows different functions in a multicellular organism to be performed efficiently at the same time.

Whilst differentiation allows multicellular organisms to become very efficient at carrying out particular functions they also lose the ability to carry out other functions. This means that if a new need arises for the cell to carry out a particular function it can usually no longer adapt to carry this out. In humans there are 220 distinctively different specialized cell types that have been identified.

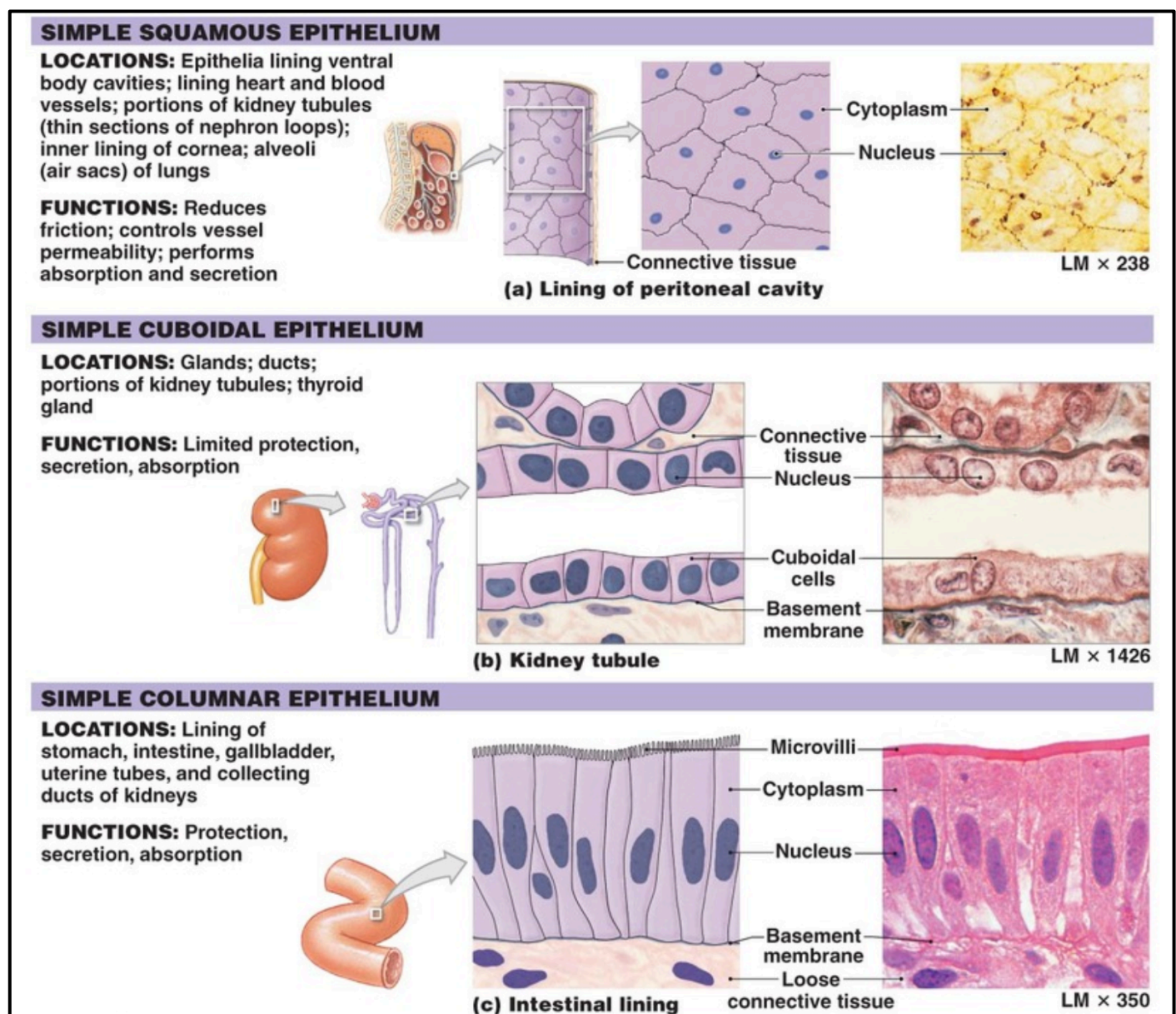
**Tissues** are made up of a collection of similar cells, extracellular matrix and body fluids. Extracellular matrix describes the material that the cells are anchored in and is produced by the cells in the tissue. Body fluids include blood, lymph and interstitial fluids.

**Classifications of Tissues:** The human body is composed of four basic types of tissues: epithelium, connective, muscular, and nervous tissues. These tissues vary in their composition and their function. (you do not need to know about nervous tissue yet).

## I. Epithelial Tissue

Epithelia form sheets of cells that have a free apical surface and a basal surface attached to a basement membrane that acts as a selective filtration barrier. There is very little intercellular (matrix) material. Epithelia do not have their own blood supply (avascular).

There are two major types of epithelia, covering epithelia and glandular epithelia.

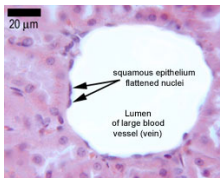




Covering Epithelia are important for:

**Selective diffusion** - for example transfer of gases, nutrients and waste products between the blood and surrounding tissues. These epithelia are usually simple squamous (square shaped) type, to provide the smallest barrier to diffusion.

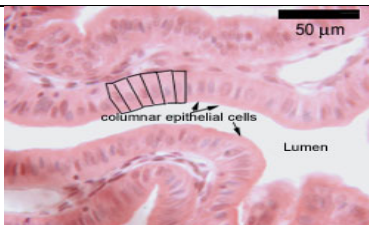
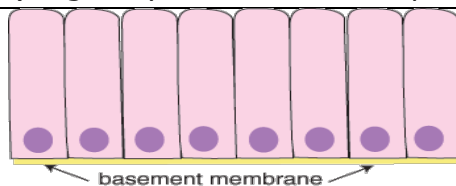
**Simple Squamous Epithelium** (Simple meaning single layered and squamous referring to the shape)



Squamous means scale-like. Simple squamous epithelium is a single layer of flat scale-shaped cells. Both the lining of blood vessels and the lining of the body cavities are simple squamous epithelium.

**Absorption/secretion** - for example absorption of nutrients from the gut, and secretion of enzymes for digestion. These epithelia are usually columnar, as the cells contain lots of endoplasmic reticulum and Golgi, for secretion, and they often have microvilli, to increase the surface area of the apical surface for absorption.

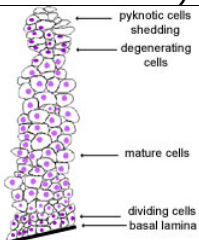
**Simple Columnar** (single layer of column shaped cells)



Tall columnar epithelium lines the ducts of many exocrine glands. This type of epithelium is adapted for secretion and/or absorption, and can also be protective. Simple secretory columnar epithelium lines the stomach and uterine cervix. The simple columnar epithelium that lines the intestine also contains a few goblet cells.

**Physical protection** - for example, the skin protects underlying tissues from sunlight, heat, cold, abrasion, etc. These epithelia are always stratified (many layers), and can sometimes be keratinised on its apical surface, as in skin. The keratin helps to waterproof the skin.

**Stratified Epithelium** (stratified meaning many layers, it can be layers of squamous or cuboidal cells)



The number of layers of cells gives a good indication of the level of abrasion that the cells have to withstand. This type of epithelium is constantly renewing itself. Cells in the bottom layer divide, and the daughter cells move towards the surface maturing and then degenerating. This type of epithelium can either be keratinising (i.e. the skin) or non-keratinising (i.e. the oesophagus). Keratinising refers to the cells dying and becoming hardened.

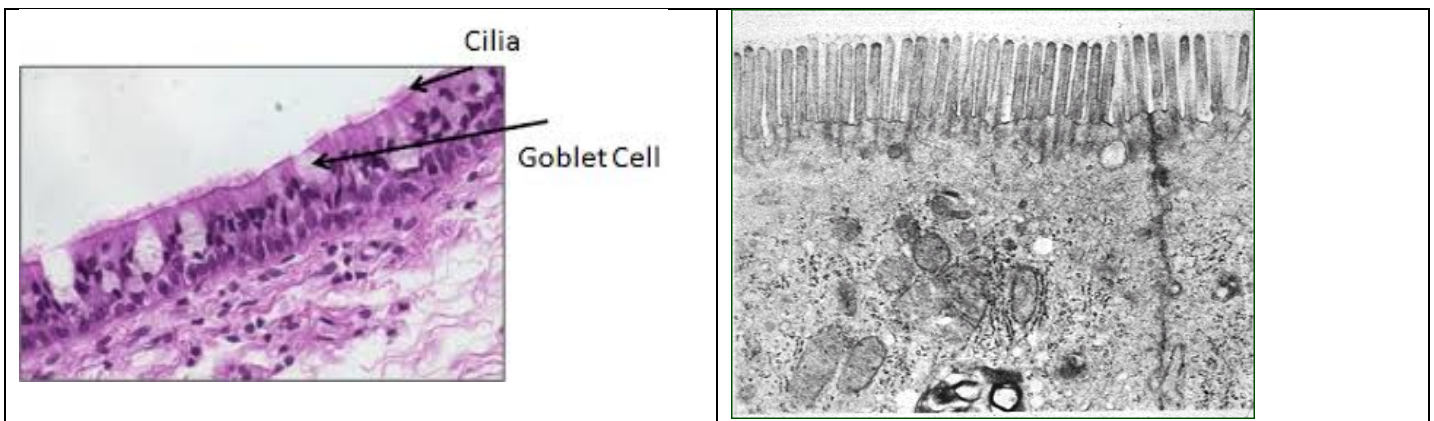
## Glandular Epithelia

### 1.2 Page 2 Tissues

**Glands are an organised collection of secretory epithelial cells.** Most glands are formed during development by proliferation of epithelial cells so that they project into the underlying connective tissue. Some glands retain their continuity with the surface via a duct and are known as EXOCRINE GLANDS. Other glands lose this direct continuity with the surface when their ducts degenerate during development. These glands are known as ENDOCRINE glands.

Epithelial cells may have features such as cilia on their surfaces (ciliated epithelial tissue) or microvilli (foldings of the plasma membrane).

Cilia are used for wafting substances such as mucus in the bronchi or an egg in the oviducts. Microvilli increase the surface area for absorption so are found in places such as the ileum and proximal convoluted tubule of the kidney.

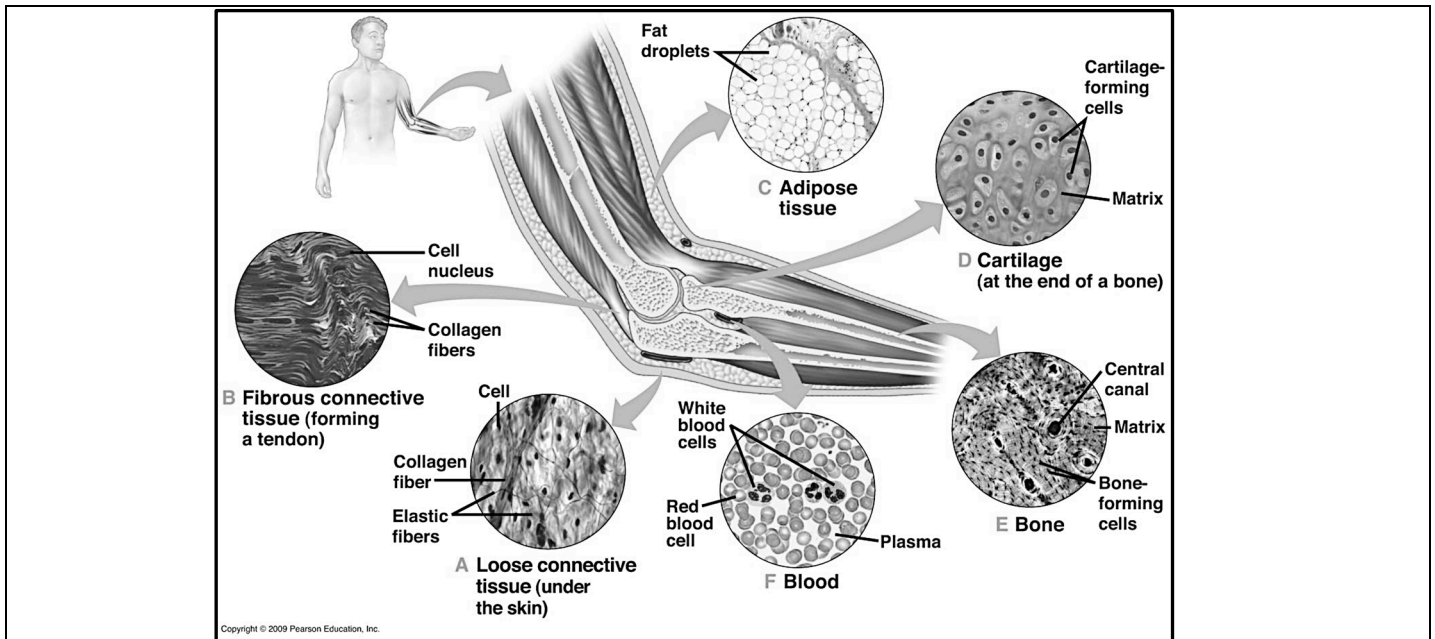


## II. Connective Tissue

Connective tissue fills the spaces between organs and tissues, and provides structural (e.g. cartilage, bone) and metabolic (e.g. adipose tissue) support for other tissues and organs. Connective tissue is made up of cells and extracellular matrix. The extracellular matrix is made up of fibers (such as collagen) in a gelatinous matrix. Both the matrix and the fibers are secreted and organised by cells in the extracellular matrix known as fibroblasts.

(For Interest: Most normal vertebrate cells cannot survive unless they are anchored to the extracellular matrix. This **anchorage dependence** is often lost when a cell turns cancerous.)

## Types of Connective Tissue



### Supporting Connective Tissue

Gives strength, support, and protection to the soft parts of the body.

**Cartilage.** Example: the outer ear

**Bone.** The matrix of bone contains collagen fibers and mineral deposits. The most abundant mineral is calcium phosphate, although magnesium, carbonate and fluoride ions are also present

### Dense connective tissue

Often called fibrous connective tissue.

**Tendons** connect muscle to bone. The matrix is principally collagen and the fibers are all oriented parallel to each other. Tendons are strong but not elastic.

**Ligaments** attach one bone to another. They contain both collagen and also the protein **elastin**. Elastin permits ligaments to be stretched.

### Loose connective tissue

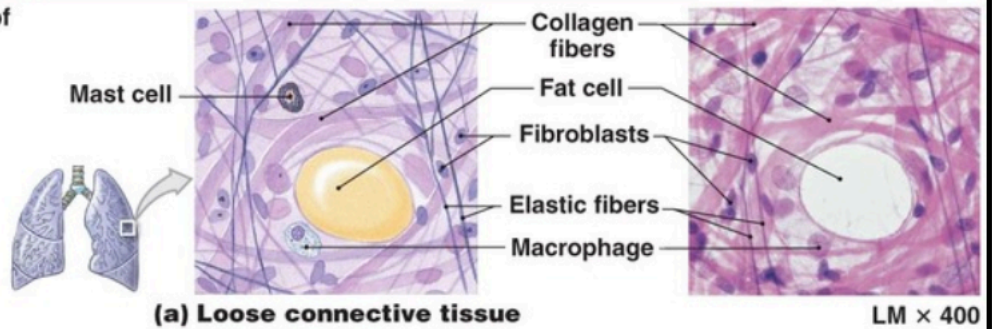
It is distributed throughout the body. It serves as a packing and binding material for most of our organs. Sheets of loose connective tissue that bind muscles and other structures together are called **fascia**. Collagen, elastin, and other proteins are found in the matrix.



## LOOSE CONNECTIVE TISSUE

**LOCATIONS:** Beneath dermis of skin, digestive tract, respiratory and urinary tracts; between muscles; around blood vessels, nerves, and around joints

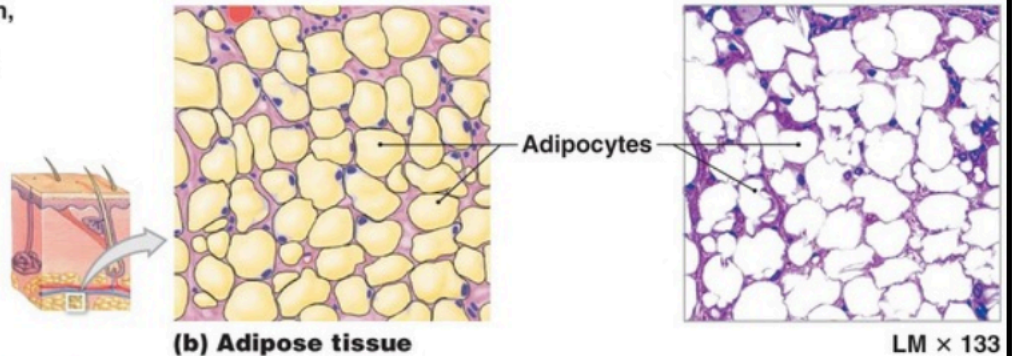
**FUNCTIONS:** Cushions organs; provides support but permits independent movement; phagocytic cells provide defense against pathogens



## ADIPOSE TISSUE

**LOCATIONS:** Deep to the skin, especially at sides, buttocks, breasts; padding around eyes and kidneys

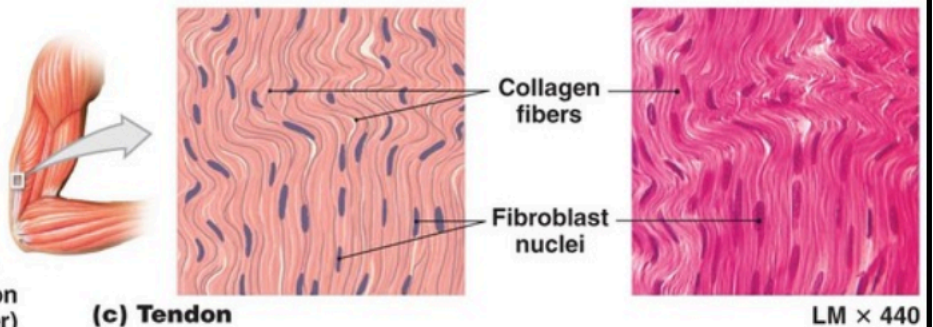
**FUNCTIONS:** Provides padding and cushions shocks; insulates (reduces heat loss); stores energy reserves



## DENSE CONNECTIVE TISSUES

**LOCATIONS:** Between skeletal muscles and skeleton (tendons); between bones (ligaments); covering skeletal muscles; capsules of internal organs

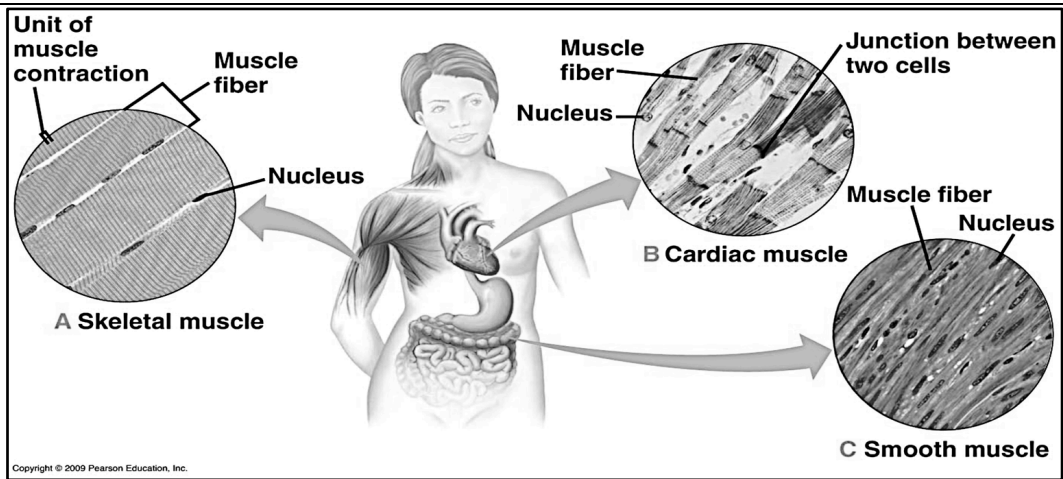
**FUNCTIONS:** Provides firm attachment; conducts pull of muscles; reduces friction between muscles; stabilizes relative positions of bones; helps prevent overexpansion of organs (such as the urinary bladder)



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## III. Muscular Tissue

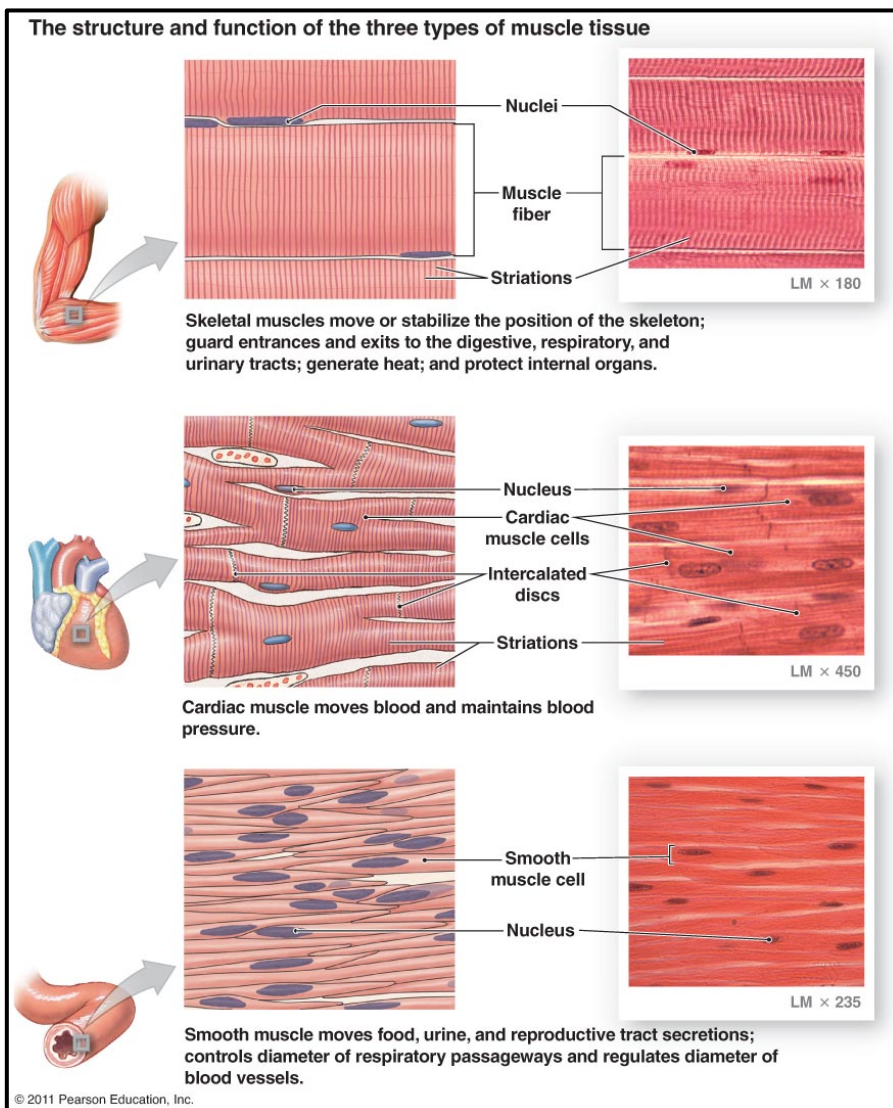
Muscle tissue is characterized by properties that allow movement. Muscle cells are excitable; they respond to a stimulus. They are contractile, meaning they can shorten and generate a pulling force. When attached between two movable objects, in other words, bones, contractions of the muscles cause the bones to move. Some muscle movement is voluntary, which means it is under conscious control. For example, a person decides to open a book and read a chapter on anatomy. Other movements are involuntary, meaning they are not under conscious control, such as the contraction of your pupil in bright light. Muscle tissue is classified into three types according to structure and function: skeletal, cardiac, and smooth.



**Smooth Muscle** – organ walls and blood vessel walls, involuntary, spindle-shaped cells for pushing things through organs.

**Skeletal Muscle** – large body muscles, voluntary, striated muscle packed in bundles and attached to bones for movement.

**Cardiac Muscle** – heart wall, involuntary, striated muscle with intercalated discs connecting cells for synchronized contractions during heart beat.



## Tasks

- i. Make a table to compare the three types of tissue, connective, epithelial and muscle.

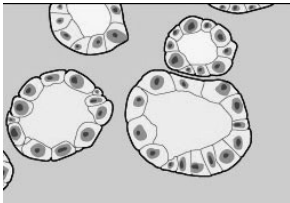
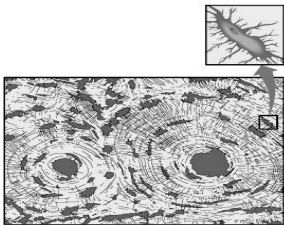
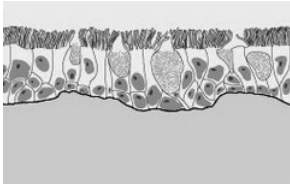
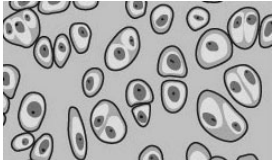
Tissue Type	Main Functions	Overall Structure	Spatial arrangement of cells	Level of Extra Cellular Matrix	Proteins fibres that might be associated with the tissue

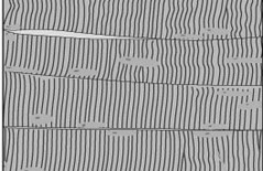
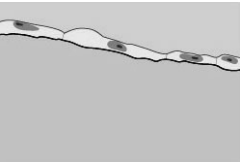
- ii. Elastin and collagen are two structural proteins found in certain types of tissues.

Tendons and ligaments are structures associated with the skeleton.

With reference to the properties of elastin and collagen and the functions of tendons and ligaments describe how and why you would expect their ratio to differ.

- iii. Identify whether the following images are epithelial, connective or muscle. If you can name them further then do so.

Image	Connective / Epithelial / Muscle	Evidence and Further Identification
	Epithelial	Simple cuboidal (single layer of cube shaped cells – kidney possibly)
		
		
		

Criteria	Self-Assessment			Teacher Assessment		
	3	2	1	3	2	1
A title clearly indicates the organ chosen						
There is a clear diagram of the organ						
The organ's main features have been clearly labeled						
The location of different tissues has been clearly shown						
Annotations have been given which explain the functions of the different tissues and how they help the organ to effectively carry out its job(this criteria is worth double marks)						
The poster is eye catching and interesting to look at						
The poster is easy to read						
Total / 27						

**Grade Rubric**

Mark/27	Grade
24-27	A
20-23	B
17-19	C
11-16	D
6-10	E
0-5	U